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Successful inflation targeting in Mozambique despite vulnerability to internal and external shocks

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Inflation has proven to be an important obstacle to successful economic adjustment in many countries. Despite both internal and external shocks to the economy, Mozambique has succeeded in controlling the inflation to gain high economic growth. This paper provides an econometric analysis of the dynamics behind the experience of Mozambique. Inflation is driven by both a purchasing power parity relation with South Africa and monetary factors. The result indicates that the country is using a crawling peg exchange rate regime.

JEL Classifications: C32, E31, E50

Keywords: inflation, purchasing power parity, money market, VAR model.

1. Introduction

After an economic collapse in the mid-1980s, Mozambique introduced a comprehensive structural adjustment program aiming at high growth and low inflation. Despite numerous external shocks during the last decade, the country has managed to attain an average annual economic growth of around 8 percent, making it one of the top ten fastest-growing economies in the world (Figure 1). The IMF (2010) predicts annual growth to continue at close to 8 percent at least until 2015.

Natural disasters and climate shocks are shocks that affect the growth in a negative way. The National Institute of Meteorology of Mozambique¹ reports that the general trend is that floods occur every year, while tropical cyclones and droughts affect the country every three to four years. Major floods as well as severe tropical cyclones happened in 2000 and 2007. Figure 1 in the statistical appendix shows that the climate shock in 2000 had a large impact on GDP, while the more severe natural disasters of 2007 had less impact, mainly due to better crisis management by the government.

Other type of shocks are supply shocks such as the high international fuel and food prices of 2007 and the world recession of 2008/2009, as well as demand shocks such as unanticipated inflows of grants and loans. Figure 2 shows that capital inflow has been rather volatile with aid fluctuating between 10 and 19 percent of GDP over the last eight years. Foreign direct investments are around ten percentage points lower, but show a similar U-pattern. The expansion of the aluminum smelter MOZAL affects the 2002/2003 figures, while the increase in later years is due to investments in exploration of natural gas and oil, as well as in mining, e.g., the Moma titanium mining project.

This paper seeks to explain the main drivers of inflation in Mozambique during 1997 to 2009. The results indicate that inflation is driven a combination of South African wholesale prices and real money balances.

2. The data series

The main variables in this study are the consumer price index for Maputo (CPI), the exchange rate against the South African rand, the producer price index for South Africa, the money stock (M2), and interpolated measures of monthly GDP (based on quarterly real GDP presented by the statistical office in Mozambique (INE)).²

INE in Mozambique publishes different price indices, but the index measuring prices in Maputo City is the only one that goes back to 1991. Since a significant part of manufacturing and services takes place in the capital, we are confident that this index is a reasonable proxy for Mozambique.

Figure 3 shows that there is an overall declining trend in the growth rates of both money and prices. The annual inflation rate is quite stable around 30-40 percent until 1996, when it drops sharply. Money supply grew by around 54 percent annually during the first six years of the 1990s. In 1996, the growth rate was reduced to only 21 percent. Since then, growth has fluctuated from 10 to 20 percent. The trend reversal in 2000 is explained by natural disasters, while the 2004 and 2005 reversals are due to drastic exchange rate changes affecting the value of foreign currency deposits at the Bank of Mozambique (BM). Finally, in 2007, climate shocks affected the money supply.

An underlying reason for the declining trend is the financial reform that Mozambique has been pursuing since the introduction of the first structural adjustment program in 1987. Initially, the reform incorporated the elimination of the markup-controlled price system. The deregulation took more than ten years to complete and revealed large repressed inflation rates. A market-determined exchange rate was introduced eliminating a premium of 40 times of a US dollar on the parallel market in 1986. The introduction followed the steps of an initial devaluation of 500 percent, a crawling peg system followed by a two-tier system, and finally an inter-bank market for foreign exchange in 1996.

¹ See www.inam.gov.mz.

² The quarterly GDP growth estimate presented by INE is merely a statistical interpolation of the annual GDP growth. We convert the quarterly measure to a monthly approximation in the same way.

BM was converted into a traditional central bank. The monetary control capacity of BM has improved over time and the introduction of government treasury bills has implied that BM could achieve monetary targeting through indirect measures instead of relying on reserve requirements and limits on domestic assets. BM follows what Stone (2003) calls a “lite” inflation targeting regime and aims at bringing inflation down to 6 percent and maintaining financial stability through monetary policies and an interventionist exchange rate policy. Due to shallow financial markets, the “lite” concept also includes fewer market-oriented monetary targets and less transparent instruments and objectives (Peires and Saxegaard, 2007). However, the “lite” regime has been criticized. Lledó (2007) means that lack of transparency implies that economic agents fail to understand the objectives and operational framework of the bank. In addition, BM at times shows weaknesses and inconsistency in the use of instruments, sending conflicting signals to the market. The bank is currently implementing a reform aimed at making the monetary policy more consistent and thus more effective. The reform includes the introduction of repurchasing agreements and reverse repurchasing agreements for short-term liquidity management and direct foreign exchange interventions in the foreign exchange market (IMF, 2009).

Monthly monetary data series are available from 1991 and, thus, the study is limited to the period 1991-2009. An initial analysis of the data shows that there is a trend break in 1997, as shown in Figure 3. Consequently, we will focus the study on the time period 1997-2009. Andersson and Sjö (2002) discuss the Mozambican success in controlling inflation during the transition to a market economy 1991-1996.

South Africa is the most important trading partner of Mozambique, accounting for 40 percent of imports and 15 percent of exports. Thus, we use the metical/rand exchange rate and South African prices.³ The producer price index is chosen over the consumer price index since it performs better in the model. Figure 4 presents the exchange rate in both log levels and as growth rates. Initial peaks in the growth rate occur in July 1992, July 1993, and July 1995; these are all due to exchange rate policies (Pimpão, 1996). The increased volatility over the years illustrates that the exchange rate is becoming more and more market-determined and thereby more sensitive to external shocks.

Figure 4 shows the log levels and first differences (growth rates) of the money stock (M2), CPI, the metical/rand exchange rate, and GDP series. Figure 5 shows that both nominal and real money stocks are growing over time. The real money stock is preferred to the nominal since it gives a better fit and a more understandable model. The figure also indicates that velocity of money⁴ displays a shift between the periods 1996-2000 and 2001-2009. The variables in our sample are non-stationary and integrated of order one, I(1). Augmented Dickey-Fuller (ADF) tests cannot reject that the series are integrated of order one and thus driven by stochastic trends.⁵ Of course, the ADF test is not applicable to the interpolated GDP series since it is not really a stochastic series after interpolation. Instead, the interpolated GDP series must be seen as type of long-run trend variable reflecting GDP growth.

3. Results

The long-run steady state relationships are examined by using the Johansen vector autoregressive model (VAR) in its vector error correction form (VECM) (Johansen 1988, 1995).⁶ The underlying VAR is made up of $\{X_t = p_t, ssa_t, ppsa_t, realm_t, y_t\}$ or domestic prices (p_t), the metical/rand exchange rate (ssa_t), South African producer prices ($ppsa_t$), real money stock ($realm_t$) and the real GDP (y_t). The model is estimated with two lags on all variables over 1997:03 to 2009:03, with income treated as exogenous and with five dummy variables; 2002:02, 2005:05, 2008:03, 2008:05, and 2008:09. South Africa's increasing inflation requires three dummy variables to remove extreme residual values.⁷

The Johansen co-integration test suggests two co-integrating vectors at the 10 per cent risk level. There is a real exchange rate relationship or purchasing power parity (PPP) indicating that inflation is driven by foreign prices. This is valid when countries rely on fixed exchange rates. There is also

³ In addition, the producer price index for USA and the USD exchange rate have been used in the study without changing the main conclusions. The rand and South African prices are chosen due to better fit and the importance of South Africa as trading partner.

⁴ Velocity is measured as real money over real GDP.

⁵ These ADF-test statistics are available upon request.

⁶ The econometric model is presented in detail in Andersson and Sjö (2002).

⁷ The tests statistics of the VAR is available on request.

a money market relation explaining inflation as the outcome of an excess supply of money. If countries rely on an exchange rate regime with freely floating exchange rates, monetary policy becomes effective and determines the inflation. Since, it was not possible to find any meaningful long-run relations using two vectors; the system was restricted to only one co-integrating vector. The final cointegrating vector becomes of stationary PPP relation and the difference between the real money stock and real income,

$$CI(ci) = p_t - 0.6068 * ppsa_t - 0.6068 * ssa_t + 1.0 * y_t - 1.0 * realm_t. \quad (3)$$

Table 2 shows that this vector is predicted mainly by domestic inflation and, to some extent, changes in real money supply (at 10 per cent risk level). Given this long-run vector, we move to model inflation in Mozambique with a single error correction model. The final results of the VECM combining both short- and long-run dynamics of the system are presented in Table 3. Inflation over the period 1997:03-2009:03 is driven by past inflation (inertia), inflation in South Africa, income growth, and adjustment to the long-run equilibrium.

In the short run, the positive autoregressive process means that a shock to inflation in the previous month will drive up inflation in the next month. Also, the previous two months of inflation in South Africa affects the inflation. Finally, income growth is associated with a falling inflation rate probably through the effect of an increased productivity and increased demand for money given an excess supply.

The adjustment to the long-run steady state inflation is driven by a combination of the real exchange rate and the money market. The long-run relation shows that South African inflation affects Mozambican prices. At the same time, increased demand for money over the existing real money stock boosts inflation as well. Our results are in line with the main conclusions of Hassan and Simione (2009), since they found a long-run relationship between the metical exchange rate and monetary market factors such as money supply and output, as well as the inflation rate.

Figure 8 shows the results of a recursive estimation of the model. Most parameters are stable and the recursive residual shows no sign of model breakdown. The co-integrating vector is to some extent changing during the sample, yet the adjustment parameter becomes stable after 2001.

Mozambique's PPP relation with South Africa is presented in Figure 6. In the first half of the 1990s, Mozambique had a higher inflation rate than South Africa and thus the exchange rate depreciated, in accordance with theory. From the time when Mozambique obtained a lower inflation rate, in line with that of South Africa, there is no longer a general tendency toward depreciation. Besides the inflation rate, the early peaks in 1993 and 1995 were due to changes in exchange rate policies (Andersson and Sjö, 2002). The depreciation in 2003 is due to the adoption of a more flexible exchange rate policy and high private capital inflow.

However, the 34 percent appreciation against the Rand in 2008 cannot be explained by the PPP relationship. During the same year, the currency also appreciated against the euro by 22 percent (Vitek, 2009), while the metical actually depreciated against the US dollar by 5 percent (see Figure 7). We can only assume that BM intervened in the exchange rate market to stabilize the exchange rate against the US dollar. Vitek (2009) considers the metical to be significantly overvalued in 2008, which of course affected the competitiveness of exports. It should be noted that restoring the competitiveness through depreciation of the metical is inflationary, and that a gradual adjustment process is of course preferred.

4. Conclusions

Mozambique has succeeded in controlling the inflation rate during the transition from a state-controlled economy to a market economy, despite initial factors such as repressed inflation, overvalued exchange rates, and huge debts. Andersson and Sjö (2002), investigating the time period 1991-1996, found that the authorities targeted a stable real exchange with South Africa by pursuing restrictive monetary and fiscal policies in combination with an exchange rate policy of continuous devaluations. The long-run steady state vector was identified as the real exchange vector. Money only drove inflation in the short run.

We find that the situation has changed in the sense that money supply now affects inflation in the long run. The long-run steady state vector depends both on the real exchange rate and monetary market factors. When money demand exceeds money supply, inflation increases. Overall, we find that inflation is driven by past inflation, South African inflation, income growth, and adjustment to the long-run equilibrium.

The fact that monetary factors are more important in explaining inflation in the 2000s is of course a result of the authorities' policy of making the value of the metical more market determined. Yet the metical is not fully market determined as evidenced by our result that the long-run vector includes both a real exchange relationship and monetary factors. Our result indicates that the Bank of Mozambique is pursuing a crawling peg exchange rate regime. However, it is not presenting this policy in a transparent way and scholars have indicated that this lack of transparency, together with other weaknesses at the bank, has implied that economic agents at times have received mixed signals.

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Statistical appendix

Figure 1: Real GDP growth in Mozambique, 1992-2008

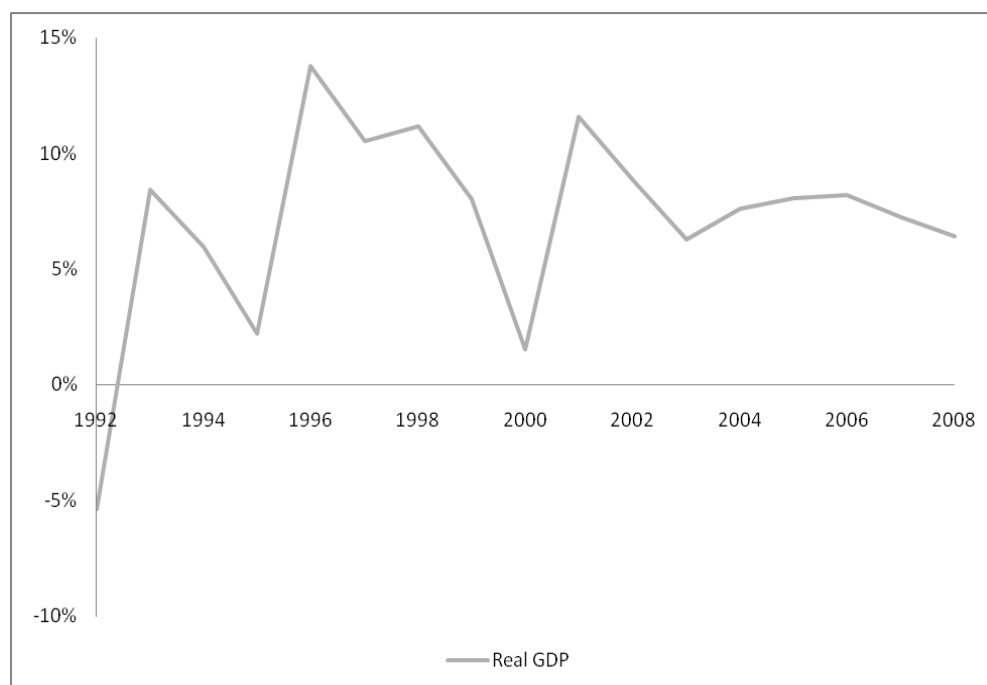


Figure 2: Aid and Private Capital Inflow in percent of GDP, 2002-2008

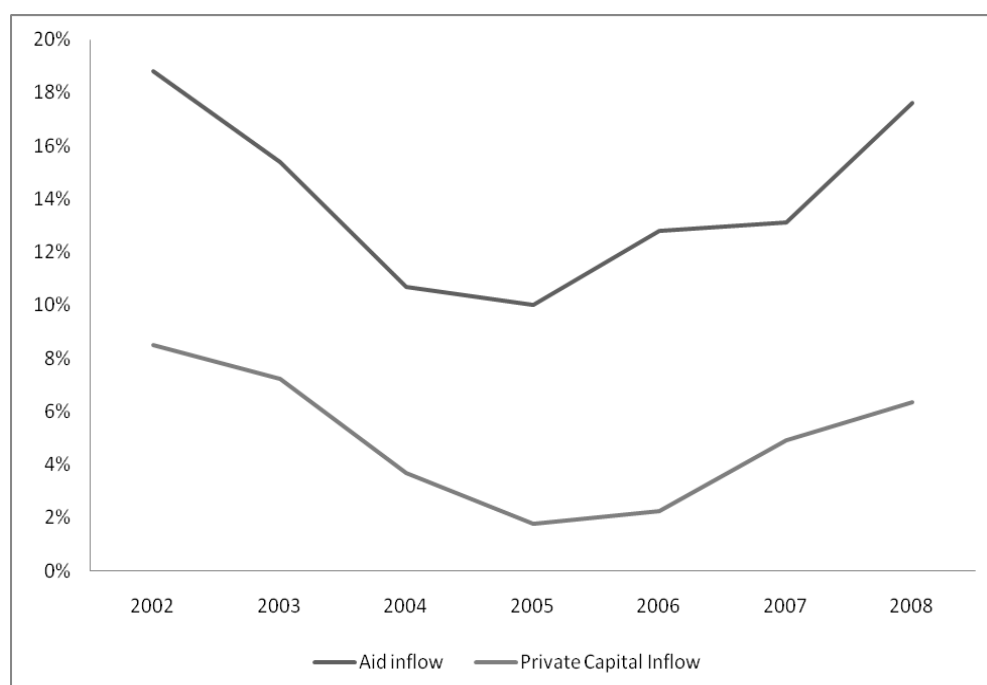


Figure 3: Annual growth in prices and money supply, 1991-2008

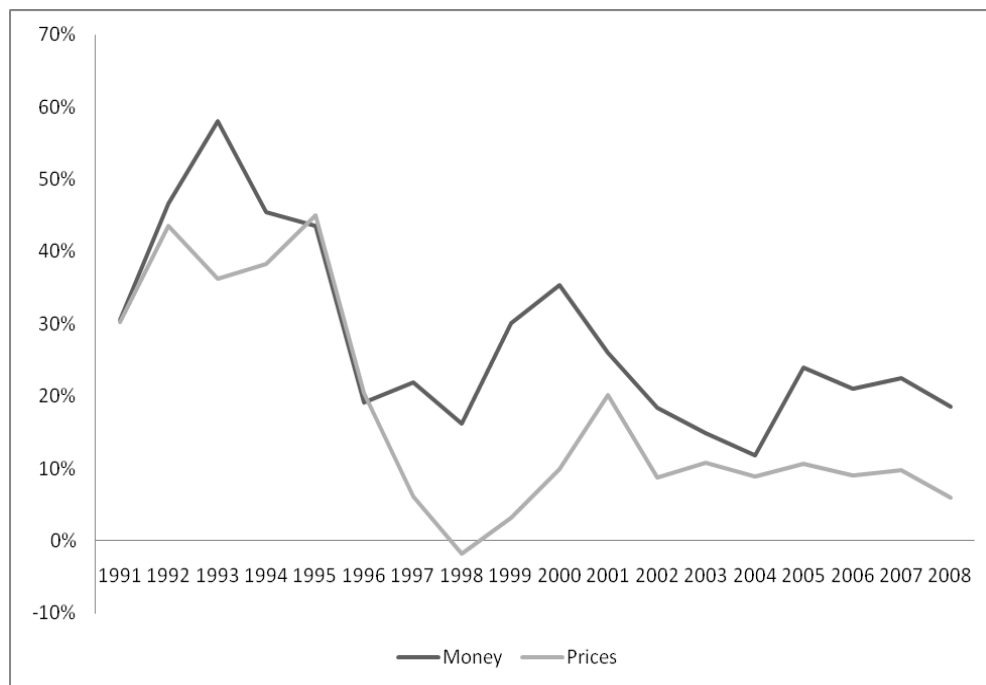


Figure 4: Money supply, CPI, exchange rate and GDP (in log form and monthly growth).

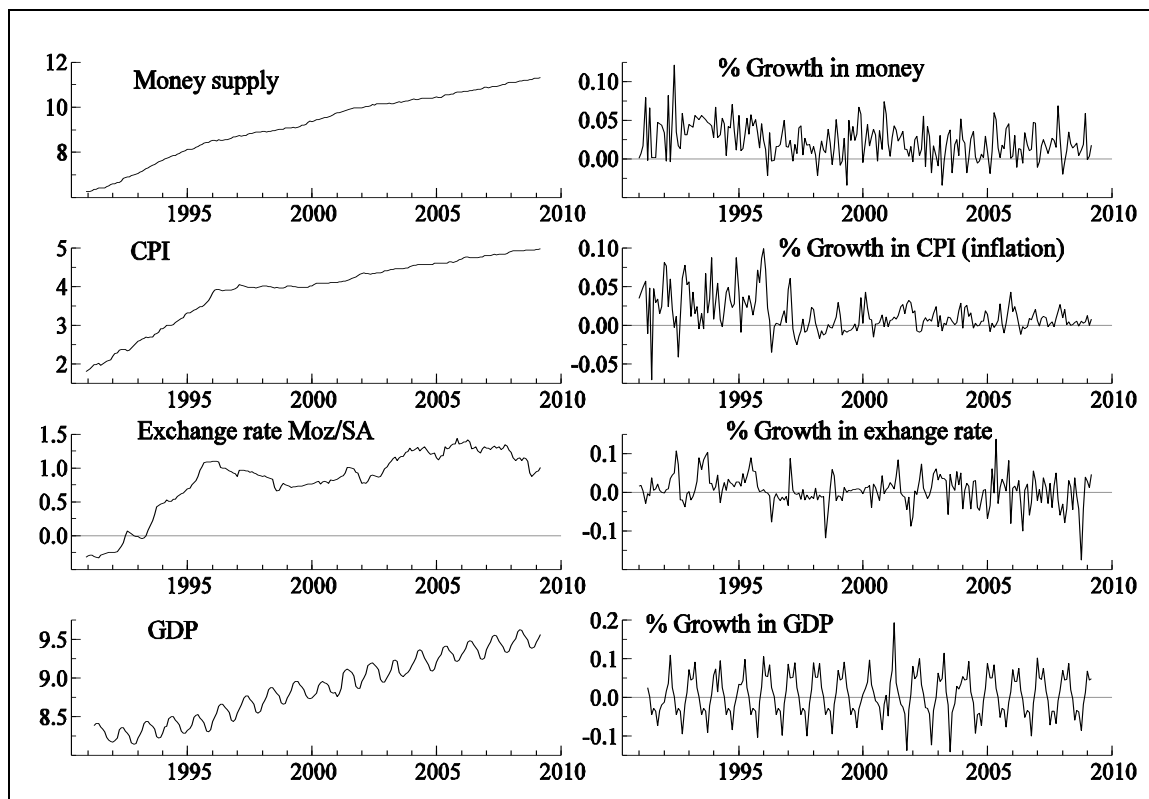


Figure 5: Nominal and real money supply as well as velocity of money

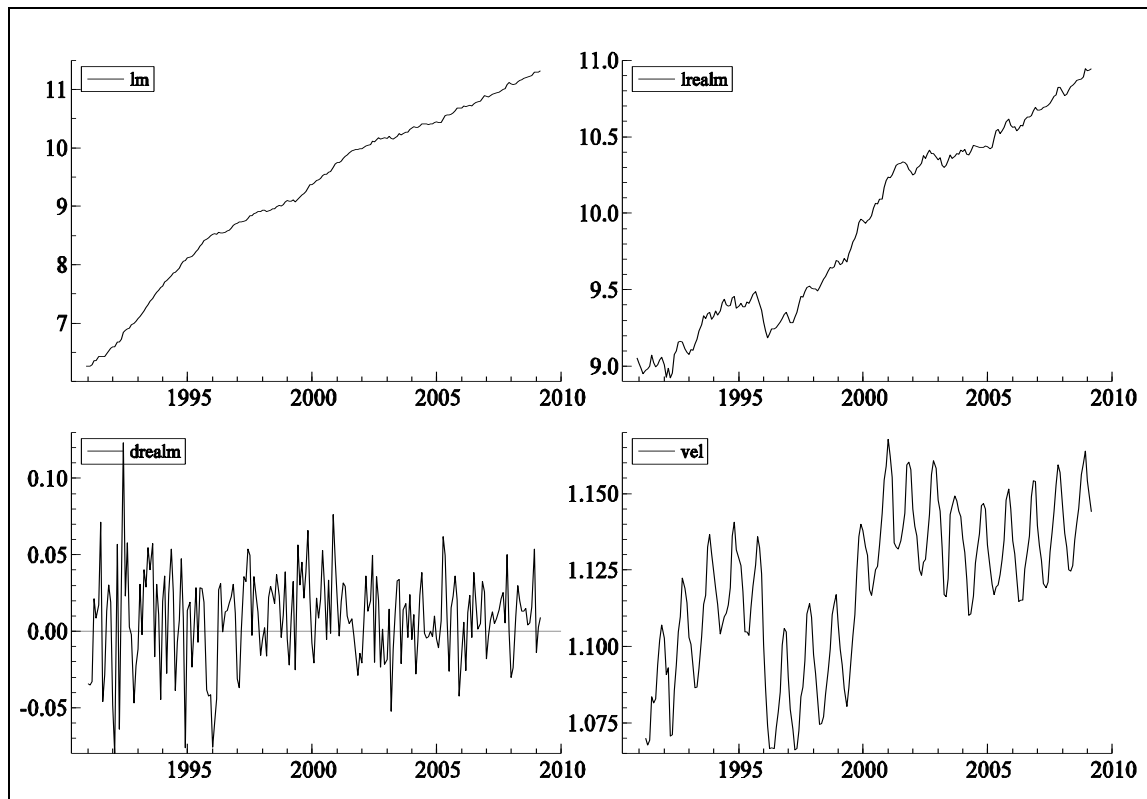


Figure 6: The PPP relation Mozambique-South Africa, 1991-2008

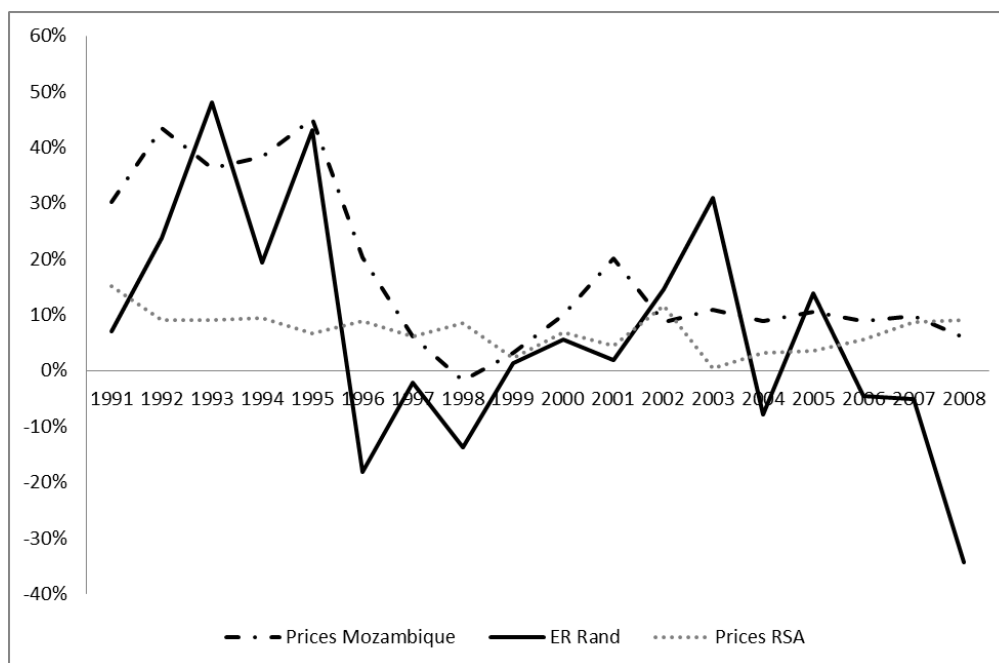


Figure 7: The PPP relation Mozambique-USA, 1991-2008

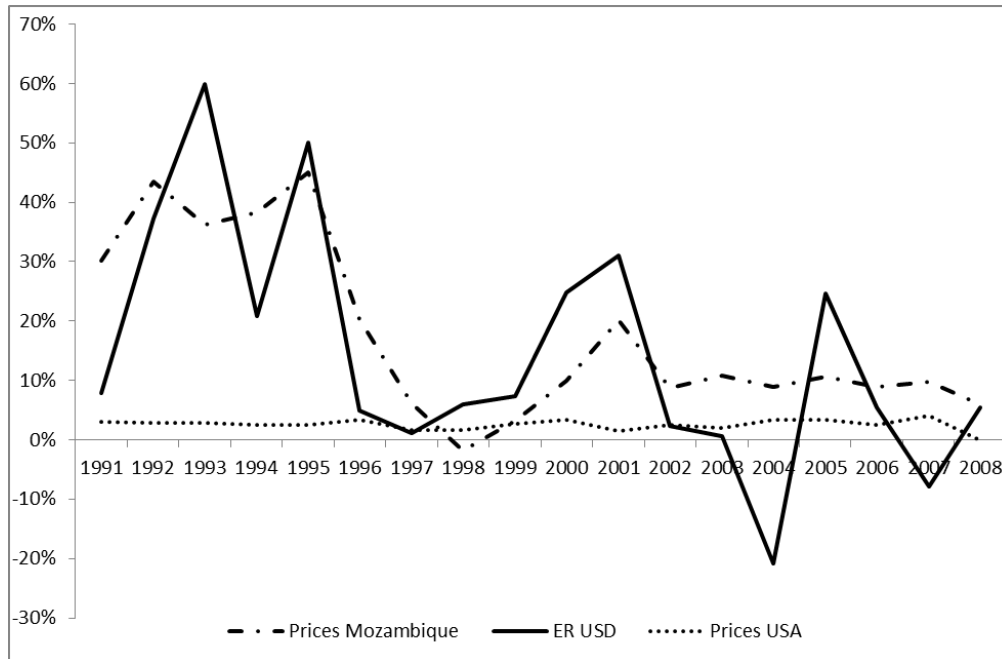


Figure 8: Recursive graphics of the inflation model

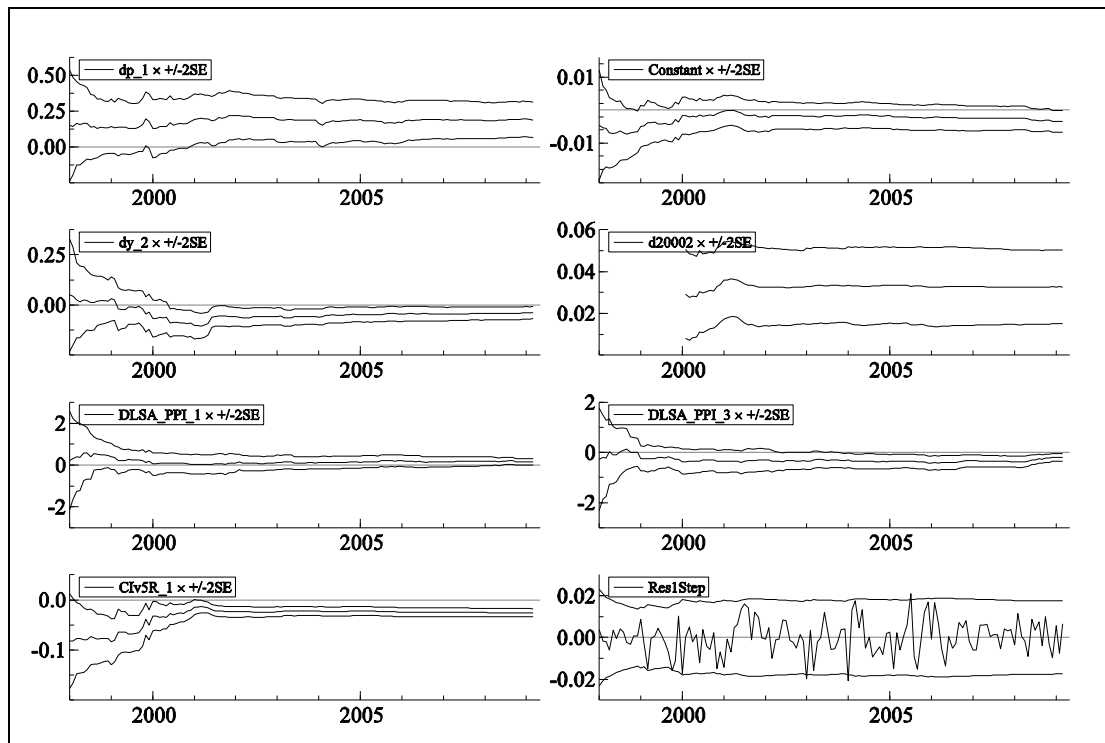


Table 1: Trace test statistics for cointegrating vectors.

Eigenvalue for rank	
	0
0.3286	1
0.1173	2
0.0551	3
0.0117	4
H0:rank<=	Trace test [Prob]
0	85.95 [0.000]**
1	28.20 [0.077]
2	10.10 [0.278]
3	2.554 [0.110]

Table 2: The alpha values of the long run vector

Equation	α -parameter	t-value
Δp_t	-0.0321	-7.83
$\Delta ppsa_t$	-0.0156	0.96
Δssa_t	0.0035	1.00
$\Delta realM_t$	0.0178	1.85

Table 3: Results of the inflation model

Variable	Coefficient	Std. Error	t-value
Δp_{-1}	0.1882	0.0617	3.05
Constant	-0.0034	0.0016	-2.12
$\Delta ppsa_{-1}$	0.1523	0.0768	1.98
$\Delta ppsa_{-2}$	-0.2009	0.0762	-2.64
Δy_{-2}	-0.0384	0.0153	-2.50
Cl(ci) ₋₁	-0.0259	0.0041	-6.28
D2000:02	0.0326	0.0088	3.71

$R^2 = 0.5178$ $F(6,138) = 24.7$ [0.000]**
 Log-likelihood = 485.326 No. of obs. 145

Test	d.g.f	Statistics	Prob.
AR 1-7 test:	$F(7,131) =$	0.6203	[0.7384]
ARCH 1-7 test:	$F(7,124) =$	1.7844	[0.0961]*
Normality test:	$\chi^2(2) =$	0.8203	[0.6635]
Hetero test:	$F(11,126) =$	1.6499	[0.0927]*
RESET test:	$F(1,137) =$	0.0128	[0.9099]